

## **REMARKS**

### **I. INTRODUCTION**

A Terminal Disclaimer and a Statement under 37 CFR 3.73(b) are submitted. Claims 1, 4-6 and 13-20 remain pending in this application. In view of the following remarks, it is respectfully submitted that all of the presently pending claims are allowable.

### **II. THE DOUBLE PATENTING REJECTION SHOULD BE WITHDRAWN**

Claims 1, 5, 6, 13 and 16-20 stand rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1, 3 and 6-9 of U.S. Patent No. 6,600,939 to Zhao. A Terminal Disclaimer along with a Statement under 37 CFR 3.73(b) are filed herewith to address this rejection. Thus, it is respectfully submitted that the obviousness-type double patenting rejection has been overcome and should be withdrawn.

### **III. THE 35 U.S.C. §102 REJECTIONS SHOULD BE WITHDRAWN**

Claims 1, 4-6, and 13-20 were rejected under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 5,801,124 issued to Gamble et al. (hereinafter "Gamble"). In addition, claims 1, 6, 13, 14, 16, 19 and 20 also were rejected under 35 U.S.C. §102(e) as being anticipated by U.S. Patent No. 6,444,917 issued to Scudiere (hereinafter "Scudiere").

The applicant's invention, as recited in independent claim 1, relates to a composite superconducting tape comprising:

**a multiplicity of stacked and diffusion-bonded superconducting tapes** and in which all elongated components extend longitudinally, and

a compatible metal tape bonded to at least one exposed major surface of the superconducting tapes.

*(Emphasis added.)*

Gamble describes a composite ceramic superconductor of improved critical current capacity, strain tolerance, critical current retention and packing factors. The improved properties resulted from the addition of a laminate that compressively strains the superconductor by at least 0.1%. (See Gamble, col. 2, lines 42-59). Although Gamble disclosed the use of metal tapes as an exterior laminate, it did not contemplate diffusion bonding the exterior metal tape onto the superconducting tapes or stacks of superconducting tapes. Instead, Gamble attaches the exterior metal tape onto the superconducting tape by rolling the tapes and soldering the two together.

Scudiere describes a composite ceramic superconductor fully encapsulated within a laminate. Exterior metal tapes are attached onto superconductor tapes or stacks of superconductor tapes to prevent cryogens from infiltrating and damaging the interior of superconductors. However, Scudiere did not contemplate the use of diffusion bonding. Rather, the exterior metal tapes are attached via a soldering or glueing process, where a layer of laminate such as solder or polymer is adhered between the surface of the superconducting tape and the exterior metal tape. (See Scudiere, col.3, lines 4-5, 21-26).

The applicant's invention recites a composite superconducting tape that includes a **multiplicity of stacked and diffusion-bonded superconducting tapes** and in which all elongated components extend longitudinally. The Examiner concedes that "Gamble et al. does not teach that the composite is made by diffusion bonding." (Office Action, 5). However, the Examiner rejects independent claim 1 and argues that "[the diffusion bonding] process limitation does not appear to patentably distinguish the product as claimed over the product of Gamble et al. and so they are believed to be substantially the same." (*Id.*, 5). Similarly the Examiner also concedes that "Scudiere et al. does not teach that the composite is made by diffusion bonding." (*Id.*, 6). However, the Examiner again rejects independent claim 1 and similarly argues that "[the diffusion bonding] process limitation does not appear to patentably distinguish the product as claimed over the product of Scudiere et al. and they are believed to be substantially the same." (*Id.*, 6). It is respectfully submitted that the Examiner's arguments are erroneous and that these claims are allowable.

The applicant's invention utilizes diffusion bonding to form a composite superconducting tape. The diffusion bond may be formed by heating the surface of the superconducting tape and the exterior metal tape to a temperature where diffusion of the metals from the two surfaces occur. As the Examiner agreed, neither Gamble nor Scudiere contemplated diffusion bonding, where molecules of surface molecules of the superconducting tapes diffuse with surface molecules of the exterior metal tape to secure a bond. (See Office Action, 5). Rather, both Gamble and Scudiere utilize a lamination technique where a laminate, whether it is ceramic, solder or polymer, coats on to or between tapes (or stacks of tapes) to secure a bond. (See Gamble, col. 11, lines 15-18; col. 12, lines 11-20; See Scudiere, col.3, lines 4-5, 21-26). In particular, both disclosed lamination processes utilizing soldering and glueing techniques that are more complicated than the diffusion bonding recited by applicant's invention. (See Gamble, col. 12, lines 11-22; Fig. 8; See Scudiere col. 3, lines 1-35). Such additional complications, for example, include Scudiere's requirement of a specific minimum diameter for the guide wheels used in the lamination process to avoid degradation of the superconducting tape. (See Id., col. 9, lines 28-32).

The Examiner nevertheless erroneously argued that the composite superconducting tape bonded by the two different processes are not patently distinguishable and that they are substantially the same. Diffusion-bonding, as recited by the applicant's invention, forms composite superconducting tapes with different characteristics as compared to composite tapes bonded by the lamination processes disclosed in Gamble and Scudiere. First, the diffusion process recited in the applicant's invention permits deformations to be added after the tapes are bonded. The ability to generate deformations after bonding increases the performance of the superconducting tape by allowing for further reduction of the cross-sectional area of a bonded stack of tapes. As disclosed in the specifications, the total cross-sectional area ( $A_{\text{tape}}$ ) is inversely related to the engineering current density ( $J_e$ ). (Specifications, p.2, lines 20-27). In addition, one skilled in the art would understand, and the applicant has also disclosed, that a higher  $J_e$  is more desirable. (See Id., p. 2, line 25). Because of the inverse relationship between cross-sectional area and  $J_e$ , the ability to introduce deformations can further decrease the cross-sectional area of a

bonded stack of tapes, increase the  $J_c$  and improve the quality of the superconductor. On the contrary, superconducting tapes bonded by lamination processes, such as those recited by Gamble and Scudiere, lack the ability to further introduce deformations, decrease cross-sectional area, and improve the quality of the resulting superconductor.

Second, the process of manufacturing composite superconducting tapes utilizing diffusion bonding requires substantially different equipment as compared to the lamination processes. The diffusion bonding process requires heating of the bonding surfaces, which may be performed by equipment commonly used in the construction of the main type of superconducting tapes, powder-in-tube (PiT) tapes. Because PiT manufacturing equipment is necessary to produce the individual superconducting tapes that form the composite superconductor, diffusion bonding does not require additional equipment. Furthermore, because the PiT process is the only widely commercially available High Temperature Superconductor (HTS) tape, the equipment to produce HTS tapes by the PiT method, can also be used for the diffusion bonding specified in the applicant's invention. On the contrary, the lamination processes recited by Gamble and Scudiere would require additional equipment. (*See* Gamble, col. 12, lines 11-20; Fig. 8; *See* Scudiere col. 8, lines 62-67; col. 9, lines 1-17). Specifically, for example, the coated conductor technology disclosed by Scudiere does not utilize machinery that would be able to laminate and bond tapes. (*See* Scudiere, col. 10, lines 61-67; col. 11, lines 1-25). Thus, the lamination process requires the purchase of additional equipment.

Lastly, composite superconducting tapes formed by lamination processes are more delicate than those formed by the diffusion bonding. Typical handling and use, such as winding onto spools for shipping or storage, winding of coils for devices, or stranding for cables may damage the interior and degrade the laminated superconductor. In addition, the lamination process includes a final heat treatment or sinter, which increases the possibility of damaging the interior of the superconductor. The added potential for degradation and damage decrease the overall quality and reliability of laminated composite superconducting tapes as opposed to diffusion bonded composite superconducting tapes recited in the present invention.

Neither Gamble nor Scudiere contemplated the use of diffusion bonds. In fact, both teach away from the use of diffusion bonds. Both Gamble and Scudiere selected exterior metal tapes that are dissimilar to the metal sheaths of the superconducting tapes and thus, unable to diffuse into each other. One skilled in the art would understand that a diffusion bond may only occur when the adjacent surfaces are physically and chemically similar, such as one of the applicant's exemplary embodiments where the sheath of the superconducting tape is of silver or silver alloy and exterior metal tape used for bonding is similarly silver or silver alloy. (Specifications, p.5, lines 5-10). Gamble and Scudiere, however, contemplated exterior metal tapes which include "stainless steel, Cu-Be alloy, aluminum, copper, nickel, or Cu-Ni alloy." (Scudiere, col. 3, lines 5-7; *See* Gamble col. 3, lines 65-67; col. 4, lines 1-4). The exterior metal tapes recited possess dissimilar properties, such as dissimilar melting points, as compared to the sheaths of the superconducting tapes which include "silver, oxide dispersion strengthened (ODS) silver, a silver alloy or a silver/gold alloy." (Gamble, col. 4, lines 46-61; *See* Scudiere, col. 5, lines 6-18). One skilled in the art would ascertain that since the exterior metal tapes and sheaths recited possess dissimilar properties, the solid state diffusion of atoms between the two cannot occur. Therefore, diffusion bonding will not take place. For example, a diffusion bond is not possible between a superconducting tape having a silver sheath and an exterior metal tape of stainless steel. Moreover, this is true with regard to all exterior metal tapes contemplated by both Gamble and Scudiere, as described above.

Thus, the applicant respectfully submits that the recitation of "diffusion bonded superconducting tapes" is patentably distinguishable from the teaching of both Gamble and Scudiere. Therefore, the applicant respectfully requests that the Examiner withdraw the rejection of claim 1 and all the claims dependent therefrom (claims 4-6).

Claim 13 also recites a composite superconducting tape constructed from a plurality of elongated superconducting tapes which each include at least one major surface, the composite superconducting tape comprising

**a diffusion-bonded stack of the plurality of superconducting tapes** in which all elongated components extend longitudinally and in which at least one of the major surfaces is exposed; and

a compatible metal tape bonded to the at least one exposed major surface.

*(Emphasis added.)*

For at least the reasons discussed above, applicant respectfully submits that claim 13 is also patentably distinguishable from Gamble and Scudiere. Therefore, applicant respectfully requests that the Examiner withdraw the rejection of claim 13 and all the claims dependent therefrom (claims 14-20).

**IV. CONCLUSION**

In light of the foregoing, the applicants respectfully submit that all of the pending claims are in condition for allowance. All issues raised by the Examiner have been addressed, an early and favorable action on the merits is earnestly solicited.

Respectfully submitted,

Dated: June 2, 2004

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